

City of Barrie's water conservation program: huge success

Innovative partnerships supporting the water conservation program and the ultraviolet disinfection system have enabled the city of Barrie to postpone for up to five years about \$19 million in capital expansions to the Water Pollution Control Centre.

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The challenge

The city of Barrie, located on Lake Simcoe, 80 kilometres north of Toronto, is one of Canada's fastest growing communities with a current population of 90,000. The main impetus for Barrie's water conservation program was the need to reduce wastewater flows at the Water Pollution Control Centre (WPCC). By 1994, average flows at the WPCC had reached 37,300 cubic metres (m³) per day, nearly 80 per cent of the design flow capacity for an average day of 46,350 m³. The city was faced with having to build a \$41 million addition to the WPCC starting in 1996 to accommodate future growth and development, as approved in the official plan.

Growth pressures were also placing constraints on the city's water supply. Currently, the Barrie Public Utilities Commission (PUC) provides all the city's water through groundwater wells. The cost of developing a new surface water supply on the shores of Kempenfelt Bay to meet growth in demand is projected to cost about \$27 million in current dollars. Plant construction was originally forecast to start in 2000.

The city was facing sewer infrastructure expansion costs of \$41 million between 1994 and the year 2000 if it didn't act to curb demands. Instead, the city chose to implement a water conservation program and to improve treatment

capabilities at the WPCC through an effluent quality upgrade (EQU). The water conservation program would prove to be beneficial not only to the city but also to residential and industrial water users as conservation savings would be reflected in their metered water charges.

The approach

Conservation partnership

The city worked with the Ontario Clean Water Agency (OCWA) and the Ministry of the Environment (MOE) in developing a conservation partnership. The city determined on a conservation program that focused on replacing, in existing homes, showerheads and toilets using high or excessive amounts of water. A strong, cost-incentive program based on rebates was developed for the homeowner. The program offered a \$145 rebate per toilet, which meant that most toilets were free to the homeowner. Any toilet upgrade costs above the \$145 rebate were the responsibility of the homeowner.

A partnership including the city, OCWA and MOE covered materials and program administration costs. Additional support was provided by Ontario Hydro, Consumers Gas, Environmental Action Barrie, the PUC and property owners. The city developed a roster of plumbing contractors who agreed to a set price for installation — \$53 for one toilet and \$85 for two.

Setting targets

New, ultralow flush (ULF) toilets — six litres per flush — approved by the Canadian Standards Association, were found to be the most cost-effective and water-efficient models to assist in meeting program goals. The goal was to obtain a 50 litre, per person, per day (L/c/d) reduction in water demands in 15,000 households — just more than 55 per cent of Barrie's 1994 housing stock. This would represent about a 5.5 per cent reduction in 1994 average day flows at the WPCC once all 15,000 households were recruited.



Deferring capital works

The reduction in wastewater flows from the water conservation program would allow the city to scale back the cost of the WPCC upgrade from \$41 million to about \$19.2 million – a savings of about \$21.8 million. Subtracting the to-date costs of the water conservation program (\$3.1 million) from the \$21.8 million in capital deferrals would result in a net capital deferral of about \$18.7 million.

All that would be required in the way of capital improvements at the WPCC over the 1994 to 2001 period would be the EQU. This work was needed to handle the increased discharges of solids associated with the projected future population growth. Construction began in 1996 and is expected to be completed in 1999.

In fact, MOE concluded that the effects of the EQU and the water conservation program were sufficient to meet projected hydraulic requirements at the WPCC to the year 2011.

Ultraviolet (UV) disinfection

As part of the EQU, the city also wanted to improve the quality of the treated effluent leaving the WPCC. Staff were looking for a treatment system that could replace chlorine as a disinfecting agent. The desire was to reduce the concentrations of chlorine derivatives finding their way into Kempenfelt Bay and Lake Simcoe.

The city decided on an ultraviolet disinfection system that will expose the wastewater to ultraviolet light before it enters Kempenfelt Bay. It was determined that this would provide the optimum — and more environmentally acceptable — way to kill bacteria in the wastewater. The UV system began operation in the spring of 1998.

The results

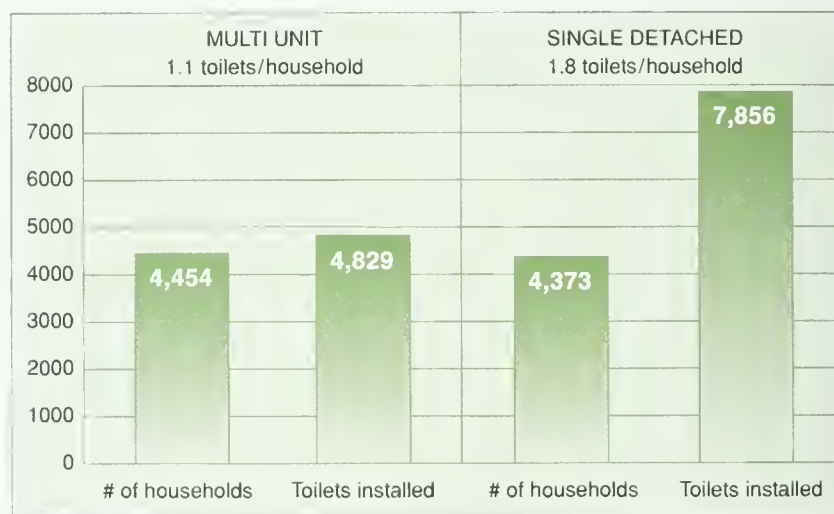
Flexible program the key to success

Enrolling in the water conservation program was easy. The city sent information kits on the program to interested homeowners and landlords. The kit included a list of eligible toilets, program guidelines and a list of the prequalified plumbing contractors. Homeowners had the option to do the installations themselves. Low flow showerheads were also offered at a rebate cost of \$8 each. The PUC provided an on-bill financing option for those homeowners who wanted to pay for the cost of installation through interest-free instalments on their water bill.

Households recruited

Between the launch of the program in February 1995 and the end of 1997, a total of 8,827 households received 12,685 ULF toilets (1.4 toilets per household for all housing types). This represents about 60 per cent of the 15,000 households the city hopes to reach. Of the 12,685 toilets installed, 7,856 went into 4,373 single-family detached homes, for an average of 1.8 toilets per home. The remaining 4,829 toilets went into 4,454 apartment units, for an average of 1.1 toilets per unit (see Figure 1). Old toilets were collected and ground up for use as aggregate material.

Figure 1 – Toilet installation rates by housing type



Water savings

Water consumption was analysed in 1,866 households both before and after the plumbing fixtures were replaced. The results of the analysis indicate a reduction in water demand of about 62 litres per person per day in participating households. This is very encouraging. Recognizing that the goal is to reduce consumption per person in participating households by 50 L/c/d, it appears that the program has bettered this target by about 20 per cent.

Wastewater flow reductions

Water savings do not directly translate into reductions in sewer flows because some of the observed savings were due to the elimination of lawn watering in the colder months. A correction factor brought the estimate of wastewater flow reductions per person down to 55 L/c/d. Based on the 8,827 households that have received the fixture replacements, the conservation program has generated about 1,335 m³/day in reductions

of wastewater flow, which is 65 per cent of the target of reduction in 1994 daily flows of 2,065 m³/day.

The other good news is that there have been no negative effects at the WPCC due to the water conservation program at each stage of the treatment process. In addition, concerns about sewer blockages due to reductions in flow volumes have proved groundless.

Public reaction to the program

Public reaction to the water conservation program has been very positive. During followup interviews with a random sample of households, more than 90 per cent of customers reported satisfaction with the way the program was administered by the city. The ULF toilets also got high marks, with 93 per cent of participants reporting they were either satisfied or very satisfied with the products installed under the program.

The costs

The costs of conservation

Between the start of the conservation program in early 1995 and the end of 1997, a total of \$3.1 million was spent. As the pie chart indicates, about 56 per cent of the total costs went to the purchase of the toilets and showerheads, 26 per cent to program administration and delivery costs (including monitoring and evaluation) and 18 per cent to homeowner costs associated with fixture installations (see Figure 2). An average of 1.4 toilets and 1.6 showerheads were installed per household at a total program cost of just under \$350 per household.

The costs of WPCC upgrades

The effluent quality upgrades currently under way at the WPCC will cost about \$19.2 million when completed, with the cost of the new UV disinfection system representing about \$0.5 million of this total. The UV system will use about \$15,000 in electricity each year to operate the UV lamps, which is a new operating cost compared to that of the old chlorine system. In addition, the maintenance costs are higher than with the chlorine system, requiring 20 person-hours per week compared to three person-hours per week for chlorine. However, these higher operation and maintenance costs represent only about a 0.5 per cent increase in the total operating and maintenance budget.

Total costs to date

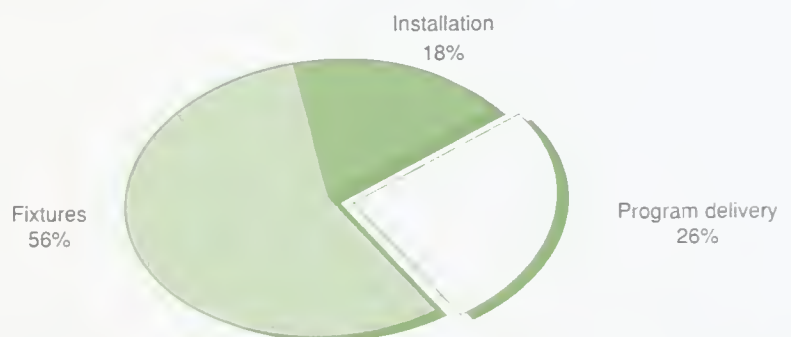
If the city had not proceeded with a program to conserve water and reduce wastewater flows, construction on WPCC expansions at a cost of about \$41 million would have commenced in 1996. For a total investment of about \$22.3 million (\$19.2 million for the effluent quality upgrades and \$3.1 million for the conservation program), the city appears to be on track to defer about \$18.7 million in WPCC expansions until 2011.

The benefits

For the homeowner

The homeowner/landlord was responsible for only the cost of the fixture installations, which averaged about \$60 per household. Assuming that the average water saving per household is 170 litres per day, a typical yearly water/wastewater reduction is 62,050 litres or 62.05 m³. At the city's combined water and sewer costs of \$.978/m³, the dollar value of these reductions amounts to about \$61 per year, for a simple payback of one year. If the homeowner had paid the total \$350 cost per household for the program, the payback would have been just under six years.

Figure 2 – Program expenditures by category



For the city

The city wins by being able to delay financing the new water and sewer capital works. At the WPCC, a combination of the water conservation program and the upgrades to the plant currently under way mean that no new hydraulic capacity will be needed until 2011. This may also enable the PUC to delay construction of the new lake-based water filtration plant beyond the year 2020. In addition, the community wins by being able to delay having to absorb the rate increases that would be needed to pay for the costs of this new infrastructure.

For the environment

The environment is a clear winner when it comes to water conservation. Reducing water demands and delaying the need to build the new filtration plant on Kempenfelt Bay delays the disruption to the aquatic environment that such a construction project would produce. As well, a reduction in sewer flows going into the WPCC (see Figure 3) may increase the hydraulic retention time of the wastewater in the plant. This allows for better and more thorough treatment. However, the increased efficiency of solids removal may increase the city's sludge disposal costs.

The UV disinfection system will generate considerable environmental benefits by eliminating the introduction of chlorine byproducts into the aquatic ecosystem in Kempenfelt Bay while providing better bacteriological treatment of the wastewater. UV has the potential to destroy bacteria, viruses and other micro-organisms in wastewater without using chemicals. Limiting the use of chemicals is not only beneficial to the environment but also reduces chemical storage and handling concerns.

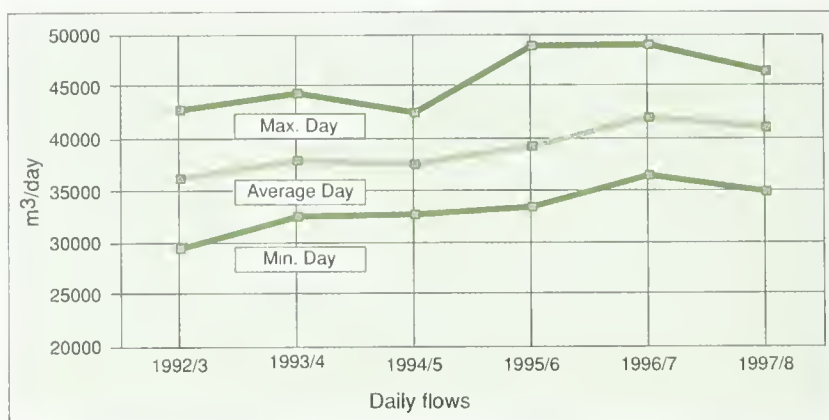
For the community

There are broader community benefits associated with the Barrie conservation program that are equally important to highlight. In addition to the environmental and resource conservation benefits, the program has generated considerable benefits for the Barrie economy.

For example, OCWA calculated that about 825 more jobs would be created through the conservation program compared to the capital works originally proposed during the next 15 years. The job creation benefits stem from the labor-intensive nature of the conservation program.

The other economic benefit stems from the fact that most people still spend the money they save from lower water and energy bills. This money is being injected back into the Barrie economy, where it generates more jobs and greater tax revenues for all levels of government. And while the homeowner spends only once to purchase and install a low flow toilet and shower-head, that same homeowner continues to spend the savings from conservation year after year.

Figure 3 – Daily flow summary at the WPCC



The bottom line

The bottom line is compelling — environmental benefits, job creation, increased disposable incomes from lower water and energy bills and the deferral of \$18.7 million in municipal wastewater treatment expenditures. By initiating one of the largest water conservation projects in Canada, Barrie is proving that water conservation can play an integral role in the wider strategic planning involving the provision of municipal water and sewer services. Water conservation works, it saves taxpayers money and it's good for the environment.

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